National Semiconductor

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LM3914
Dot/Bar Display Driver

General Description

The LM3914 is a monolithic integrated circuit that senses analog voltage levels and drives 10 LEDs, providing a linear analog display. A single pin changes the display from a moving dot to a bar graph. Current drive to the LEDs is regulated and programmable, eliminating the need for resistors. This feature is one that allows operation of the whole system from less than 3V.

The circuit contains its own adjustable reference and accurate 10-step voltage divider. The low-bias-current input buffer accepts signals down to ground, or V^-, yet needs no protection against inputs of 35V above or below ground. The buffer drives 10 individual comparators referenced to the precision divider. Indication non-linearity can thus be held typically to ½%, even over a wide temperature range.

Versatility was designed into the LM3914 so that controller, visual alarm, and expanded scale functions are easily added on to the display system. The circuit can drive LEDs of many colors, or low-current incandescent lamps. Many LM3914s can be "chained" to form displays of 20 to over 100 segments. Both ends of the voltage divider are externally available so that 2 drivers can be made into a zero-center meter.

The LM3914 is very easy to apply as an analog meter circuit. A 1.2V full-scale meter requires only 1 resistor and a single 3V to 15V supply in addition to the 10 display LEDs. If the 1 resistor is a pot, it becomes the LED brightness control. The simplified block diagram illustrates this extremely simple external circuitry.

When in the dot mode, there is a small amount of overlap or "fade" (about 1 mV) between segments. This assures that at no time will all LEDs be "OFF", and thus any ambiguous display is avoided. Various novel displays are possible.

Much of the display flexibility derives from the fact that all outputs are individual, DC regulated currents. Various effects can be achieved by modulating these currents. The individual outputs can drive a transistor as well as a LED at the same time, so controller functions including "staging" control can be performed. The LM3914 can also act as a programmer, or sequencer.

The LM3914 is rated for operation from 0˚C to +70˚C. The LM3914N-1 is available in an 18-lead molded (N) package.

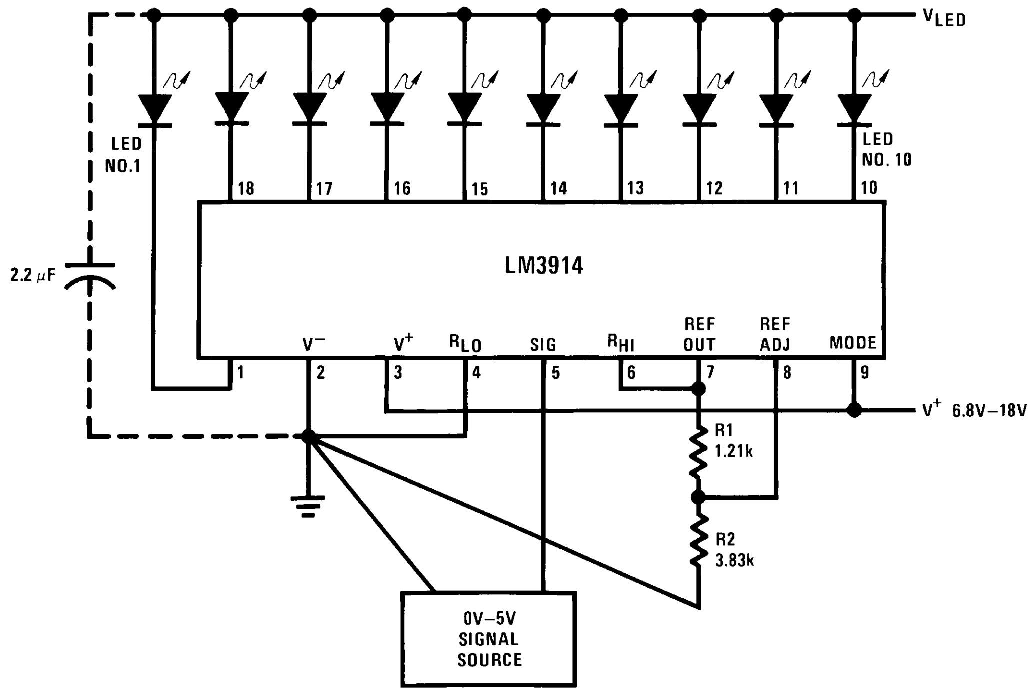
The following typical application illustrates adjusting of the reference to a desired value, and proper grounding for accurate operation, and avoiding oscillations.

Features

- Drives LEDs, LCDs or vacuum fluorescents
- Bar or dot display mode externally selectable by user
- Expandable to displays of 100 steps
- Internal voltage reference from 1.2V to 12V
- Operates with single supply of less than 3V
- Inputs operate down to ground
- Output current programmable from 2 mA to 30 mA
- No multiplex switching or interaction between outputs
- Input withstands ±35V without damage or false outputs
- LED driver outputs are current regulated, open-collectors
- Outputs can interface with TTL or CMOS logic
- The internal 10-step divider is floating and can be referenced to a wide range of voltages

Typical Applications

0V to 5V Bar Graph Meter



00797001

$$\text{Ref Out V} = 1.25\left(1 + \frac{R2}{R1}\right)$$

$$I_{LED} \cong \frac{12.5}{R1}$$

Note: Grounding method is typical of *all* uses. The 2.2µF tantalum or 10 µF aluminum electrolytic capacitor is needed if leads to the LED supply are 6" or longer.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Power Dissipation (Note 6)	
Molded DIP (N)	1365 mW
Supply Voltage	25V
Voltage on Output Drivers	25V
Input Signal Overvoltage (Note 4)	±35V
Divider Voltage	−100 mV to V^+
Reference Load Current	10 mA
Storage Temperature Range	−55˚C to +150˚C
Soldering Information	
Dual-In-Line Package	
Soldering (10 seconds)	260˚C
Plastic Chip Carrier Package	
Vapor Phase (60 seconds)	215˚C
Infrared (15 seconds)	220˚C

See AN-450 “Surface Mounting Methods and Their Effect on Product Reliability” for other methods of soldering surface mount devices.

Electrical Characteristics (Notes 2, 4)

Parameter	Conditions (Note 2)	Min	Typ	Max	Units
COMPARATOR					
Offset Voltage, Buffer and First Comparator	0V ≤ V_{RLO} = V_{RHI} ≤ 12V, I_{LED} = 1 mA		3	10	mV
Offset Voltage, Buffer and Any Other Comparator	0V ≤ V_{RLO} = V_{RHI} ≤ 12V, I_{LED} = 1 mA		3	15	mV
Gain ($\Delta I_{LED}/\Delta V_{IN}$)	$I_{L(REF)}$ = 2 mA, I_{LED} = 10 mA	3	8		mA/mV
Input Bias Current (at Pin 5)	0V ≤ V_{IN} ≤ V^+ − 1.5V		25	100	nA
Input Signal Overvoltage	No Change in Display	−35		35	V
VOLTAGE-DIVIDER					
Divider Resistance	Total, Pin 6 to 4	8	12	17	kΩ
Accuracy	(Note 3)		0.5	2	%
VOLTAGE REFERENCE					
Output Voltage	0.1 mA ≤ $I_{L(REF)}$ ≤ 4 mA, V^+ = V_{LED} = 5V	1.2	1.28	1.34	V
Line Regulation	3V ≤ V^+ ≤ 18V		0.01	0.03	%/V
Load Regulation	0.1 mA ≤ $I_{L(REF)}$ ≤ 4 mA, V^+ = V_{LED} = 5V		0.4	2	%
Output Voltage Change with Temperature	0˚C ≤ T_A ≤ +70˚C, $I_{L(REF)}$ = 1 mA, V^+ = 5V		1		%
Adjust Pin Current			75	120	µA
OUTPUT DRIVERS					
LED Current	V^+ = V_{LED} = 5V, $I_{L(REF)}$ = 1 mA	7	10	13	mA
LED Current Difference (Between Largest and Smallest LED Currents)	V_{LED} = 5V, I_{LED} = 2 mA		0.12	0.4	mA
	V_{LED} = 5V, I_{LED} = 20 mA		1.2	3	mA
LED Current Regulation	2V ≤ V_{LED} ≤ 17V, I_{LED} = 2 mA		0.1	0.25	mA
	2V ≤ V_{LED} ≤ 17V, I_{LED} = 20 mA		1	3	mA
Dropout Voltage	$I_{LED(ON)}$ = 20 mA, V_{LED} = 5V, ΔI_{LED} = 2 mA			1.5	V
Saturation Voltage	I_{LED} = 2.0 mA, $I_{L(REF)}$ = 0.4 mA		0.15	0.4	V
Output Leakage, Each Collector	(Bar Mode) (Note 5)		0.1	10	µA
Output Leakage	(Dot Mode) (Note 5), Pins 10–18		0.1	10	µA
	(Dot Mode) (Note 5), Pin 1	60	150	450	µA
SUPPLY CURRENT					
Standby Supply Current (All Outputs Off)	V^+ = 5V, $I_{L(REF)}$ = 0.2 mA		2.4	4.2	mA
	V^+ = 20V, $I_{L(REF)}$ = 1.0 mA		6.1	9.2	mA

Electrical Characteristics (Notes 2, 4) (Continued)

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. Electrical Characteristics state DC and AC electrical specifications under particular test conditions which guarantee specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not guaranteed for parameters where no limit is given, however, the typical value is a good indication of device performance.

Note 2: Unless otherwise stated, all specifications apply with the following conditions:

$3\ V_{DC} \le V^+ \le 20\ V_{DC}$ $V_{REF}, V_{RHI}, V_{RLO} \le (V^+ - 1.5V)$

$3\ V_{DC} \le V_{LED} \le V^+$ $0V \le V_{IN} \le V^+ - 1.5V$

$-0.015V \le V_{RLO} \le 12V_{DC}$ $T_A = +25°C$, $I_{L(REF)} = 0.2$ mA, $V_{LED} = 3.0V$, pin 9 connected to pin 3 (Bar Mode).

$-0.015V \le V_{RHI} \le 12\ V_{DC}$

For higher power dissipations, pulse testing is used.

Note 3: Accuracy is measured referred to $+10.000V_{DC}$ at pin 6, with $0.000\ V_{DC}$ at pin 4. At lower full-scale voltages, buffer and comparator offset voltage may add significant error.

Note 4: Pin 5 input current must be limited to ±3mA. The addition of a 39k resistor in series with pin 5 allows ±100V signals without damage.

Note 5: Bar mode results when pin 9 is within 20mV of V^+. Dot mode results when pin 9 is pulled at least 200mV below V^+ or left open circuit. LED No. 10 (pin 10 output current) is disabled if pin 9 is pulled 0.9V or more below V_{LED}.

Note 6: The maximum junction temperature of the LM3914 is 100˚C. Devices must be derated for operation at elevated temperatures. Junction to ambient thermal resistance is 55˚C/W for the molded DIP (N package).

Definition of Terms

Accuracy: The difference between the observed threshold voltage and the ideal threshold voltage for each comparator. Specified and tested with 10V across the internal voltage divider so that resistor ratio matching error predominates over comparator offset voltage.

Adjust Pin Current: Current flowing out of the reference adjust pin when the reference amplifier is in the linear region.

Comparator Gain: The ratio of the change in output current (I_{LED}) to the change in input voltage (V_{IN}) required to produce it for a comparator in the linear region.

Dropout Voltage: The voltage measured at the current source outputs required to make the output current fall by 10%.

Input Bias Current: Current flowing out of the signal input when the input buffer is in the linear region.

LED Current Regulation: The change in output current over the specified range of LED supply voltage (V_{LED}) as measured at the current source outputs. As the forward voltage of an LED does not change significantly with a small change in forward current, this is equivalent to changing the voltage at the LED anodes by the same amount.

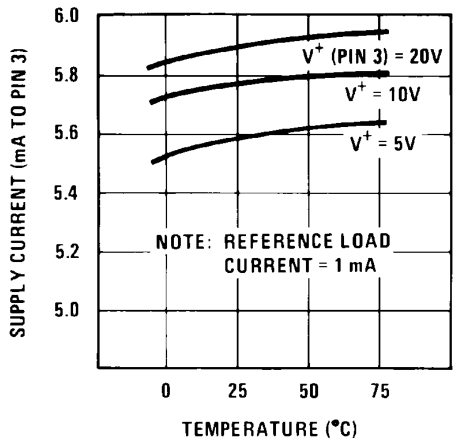
Line Regulation: The average change in reference output voltage over the specified range of supply voltage (V^+).

Load Regulation: The change in reference output voltage (V_{REF}) over the specified range of load current ($I_{L(REF)}$).

Offset Voltage: The differential input voltage which must be applied to each comparator to bias the output in the linear region. Most significant error when the voltage across the internal voltage divider is small. Specified and tested with pin 6 voltage (V_{RHI}) equal to pin 4 voltage (V_{RLO}).

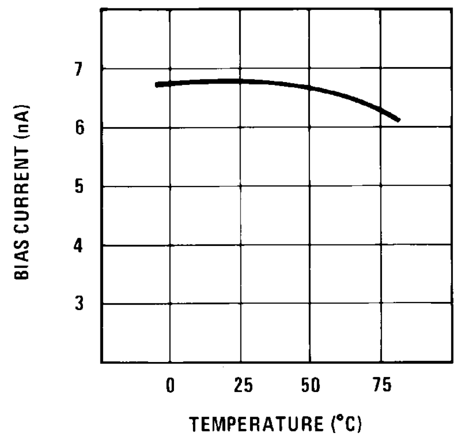
Typical Performance Characteristics

Supply Current vs Temperature



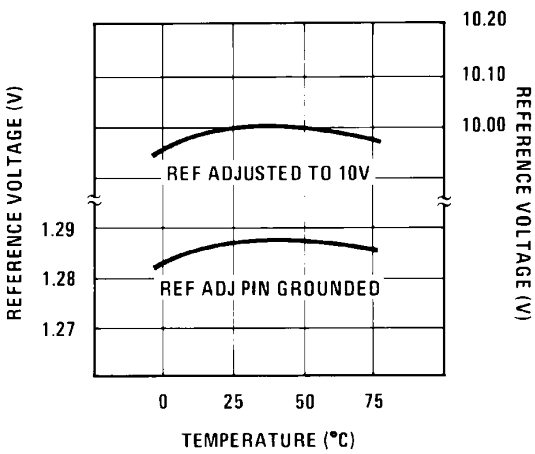
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Operating Input Bias Current vs Temperature



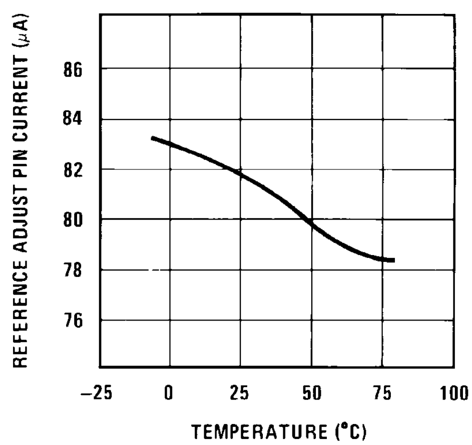
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Reference Voltage vs Temperature



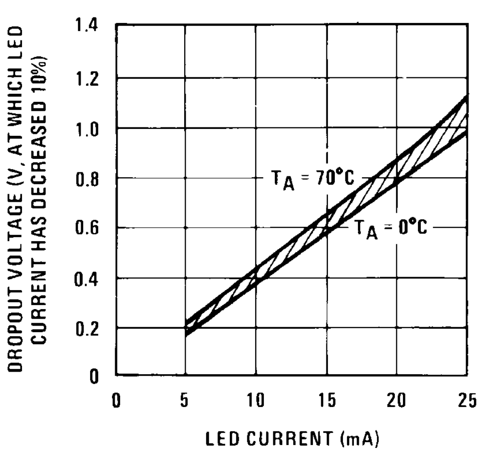
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Reference Adjust Pin Current vs Temperature



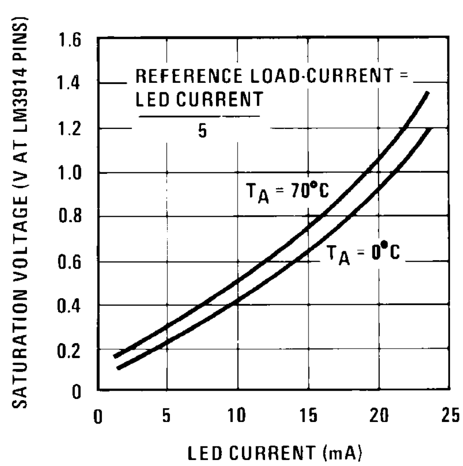
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LED Current-Regulation Dropout



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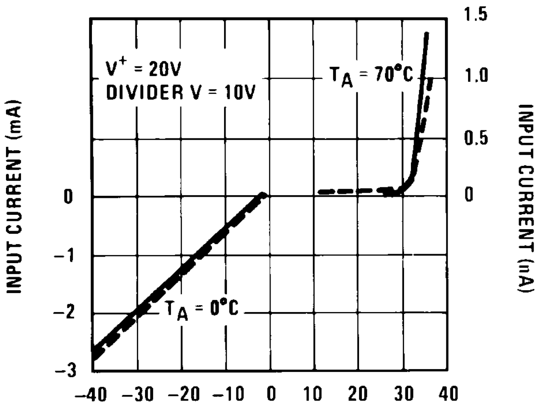
LED Driver Saturation Voltage



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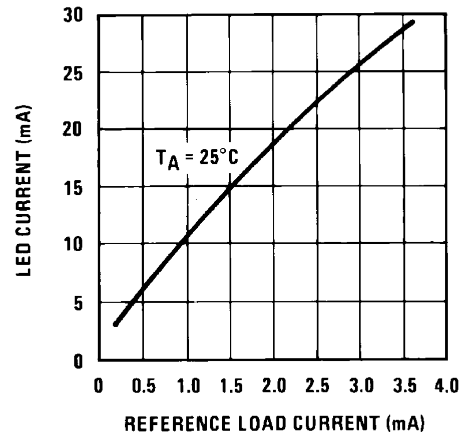
Typical Performance Characteristics (Continued)

Input Current Beyond Signal Range (Pin 5)



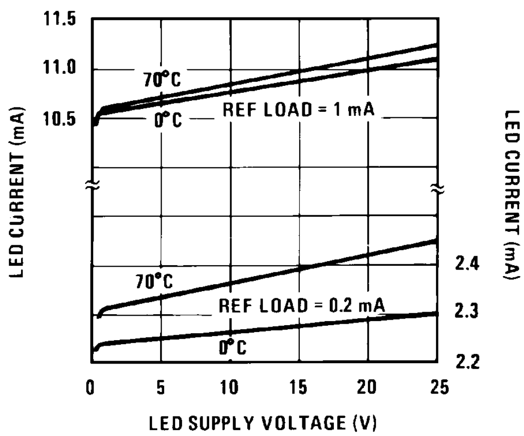
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LED Current vs Reference Loading



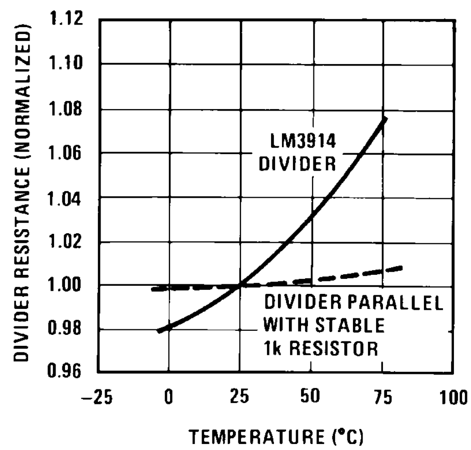
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LED Driver Current Regulation



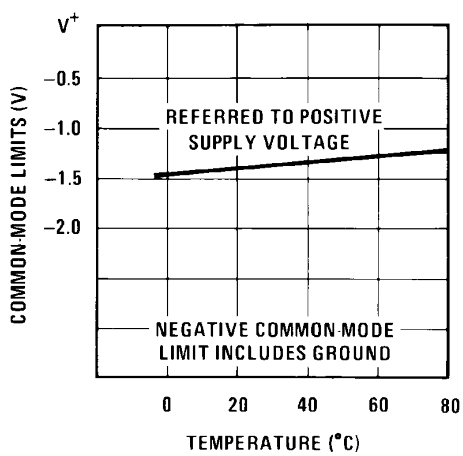
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Total Divider Resistance vs Temperature



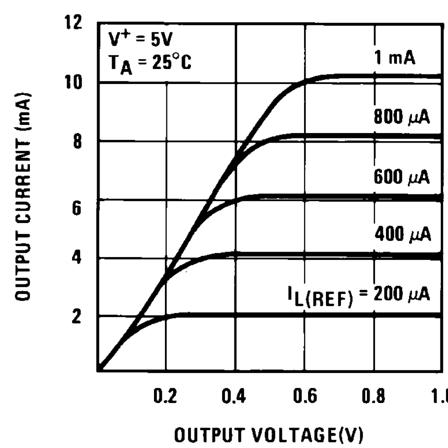
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Common-Mode Limits



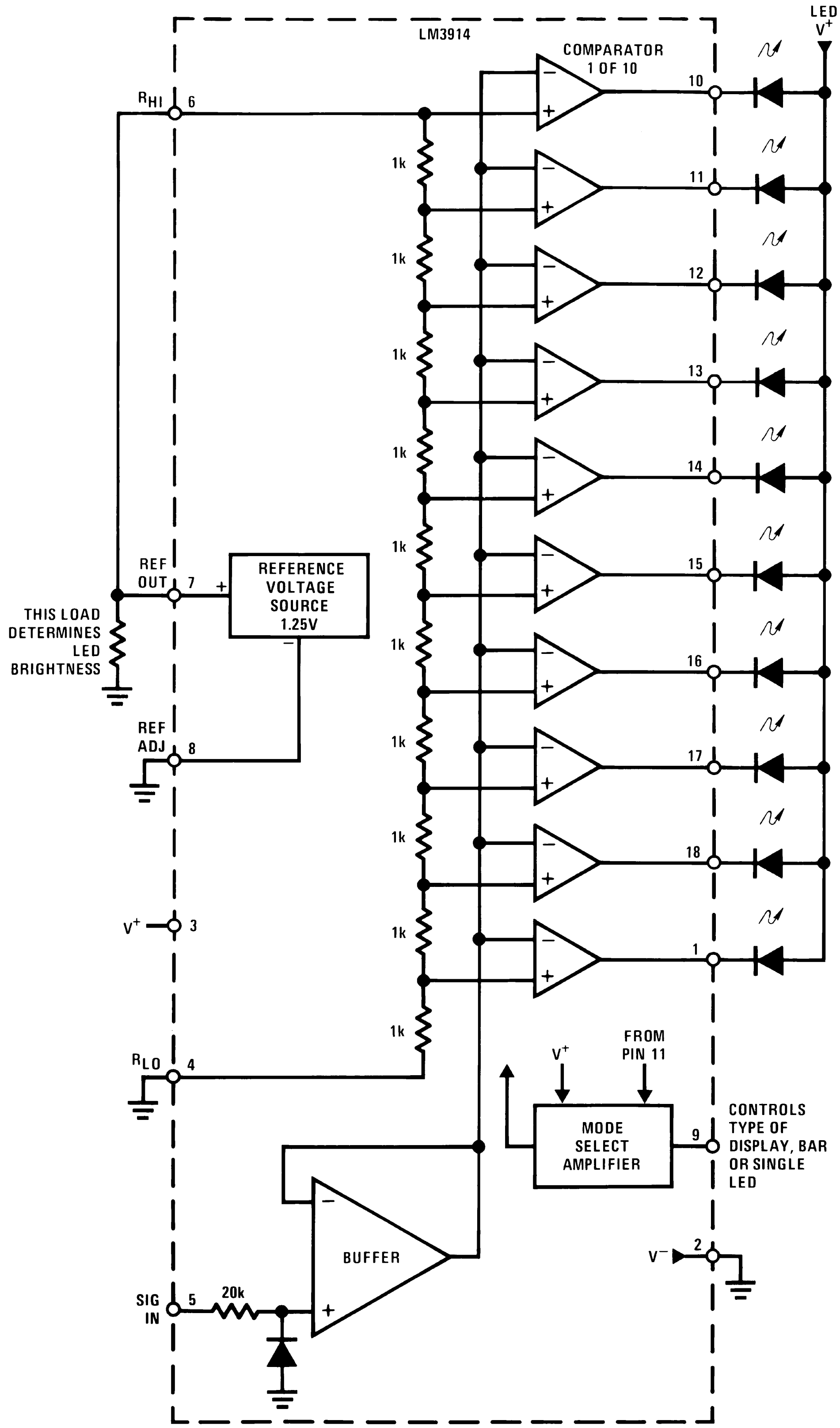
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Output Characteristics



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Block Diagram (Showing Simplest Application)



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Functional Description

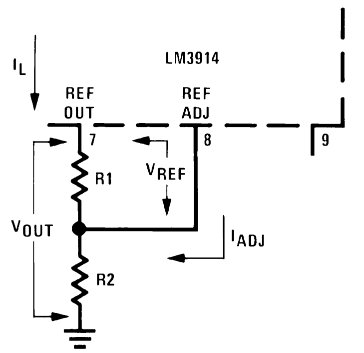
The simplifed LM3914 block diagram is to give the general idea of the circuit's operation. A high input impedance buffer operates with signals from ground to 12V, and is protected against reverse and overvoltage signals. The signal is then applied to a series of 10 comparators; each of which is biased to a different comparison level by the resistor string.

In the example illustrated, the resistor string is connected to the internal 1.25V reference voltage. In this case, for each 125mV that the input signal increases, a comparator will switch on another indicating LED. This resistor divider can be connected between any 2 voltages, providing that they are 1.5V below V^+ and no less than V^-. If an expanded scale meter display is desired, the total divider voltage can be as little as 200mV. Expanded-scale meter displays are more accurate and the segments light uniformly only if bar mode is used. At 50mV or more per step, dot mode is usable.

INTERNAL VOLTAGE REFERENCE

The reference is designed to be adjustable and develops a nominal 1.25V between the REF OUT (pin 7) and REF ADJ (pin 8) terminals. The reference voltage is impressed across program resistor R1 and, since the voltage is constant, a constant current I_1 then flows through the output set resistor R2 giving an output voltage of:

$$V_{OUT} = V_{REF}\left(1 + \frac{R2}{R1}\right) + I_{ADJ}R_2$$



00797004

Since the 120μA current (max) from the adjust terminal represents an error term, the reference was designed to minimize changes of this current with V^+ and load changes.

CURRENT PROGRAMMING

A feature not completely illustrated by the block diagram is the LED brightness control. The current drawn out of the reference voltage pin (pin 7) determines LED current. Approximately 10 times this current will be drawn through each lighted LED, and this current will be relatively constant despite supply voltage and temperature changes. Current drawn by the internal 10-resistor divider, as well as by the external current and voltage-setting divider should be included in calculating LED drive current. The ability to modulate LED brightness with time, or in proportion to input voltage and other signals can lead to a number of novel displays or ways of indicating input overvoltages, alarms, etc.

MODE PIN USE

Pin 9, the Mode Select input controls chaining of multiple LM3914s, and controls bar or dot mode operation. The following tabulation shows the basic ways of using this input. Other more complex uses will be illustrated in the applications.

Bar Graph Display: Wire Mode Select (pin 9) *directly* to pin 3 (V^+ pin).

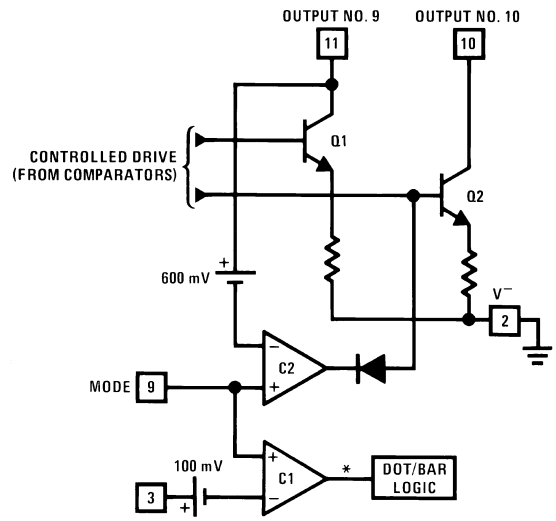
Dot Display, Single LM3914 Driver: Leave the Mode Select pin open circuit.

Dot Display, 20 or More LEDs: Connect pin 9 of the *first* driver in the series (i.e., the one with the lowest input voltage comparison points) to pin 1 of the next higher LM3914 driver. Continue connecting pin 9 of lower input drivers to pin 1 of higher input drivers for 30, 40, or more LED displays. The last LM3914 driver in the chain will have pin 9 wired to pin 11. All previous drivers should have a 20k resistor in parallel with LED No. 9 (pin 11 to V_{LED}).

Mode Pin Functional Description

This pin actually performs two functions. Refer to the simplified block diagram below.

Block Diagram of Mode Pin Description



00797005

*High for bar

DOT OR BAR MODE SELECTION

The voltage at pin 9 is sensed by comparator C1, nominally referenced to (V^+ – 100mV). The chip is in bar mode when pin 9 is above this level; otherwise it's in dot mode. The comparator is designed so that pin 9 can be left open circuit for dot mode.

Taking into account comparator gain and variation in the 100mV reference level, pin 9 should be no more than 20mV below V^+ for bar mode and more than 200mV below V^+ (or open circuit) for dot mode. In most applications, pin 9 is either open (dot mode) or tied to V^+ (bar mode). In bar mode, pin 9 should be connected directly to pin 3. Large currents drawn from the power supply (LED current, for example) should not share this path so that large IR drops are avoided.

Mode Pin Functional Description

(Continued)

DOT MODE CARRY

In order for the display to make sense when multiple LM3914s are cascaded in dot mode, special circuitry has been included to shut off LED No. 10 of the first device when LED No. 1 of the second device comes on. The connection for cascading in dot mode has already been described and is depicted below.

As long as the input signal voltage is below the threshold of the second LM3914, LED No. 11 is off. Pin 9 of LM3914 No. 1 thus sees effectively an open circuit so the chip is in dot mode. As soon as the input voltage reaches the threshold of LED No. 11, pin 9 of LM3914 No. 1 is pulled an LED drop (1.5V or more) below V_{LED}. This condition is sensed by comparator C2, referenced 600mV below V_{LED}. This forces the output of C2 low, which shuts off output transistor Q2, extinguishing LED No. 10.

V_{LED} is sensed via the 20k resistor connected to pin 11. The very small current (less than 100μA) that is diverted from LED No. 9 does not noticeably affect its intensity.

An auxiliary current source at pin 1 keeps at least 100μA flowing through LED No. 11 even if the input voltage rises high enough to extinguish the LED. This ensures that pin 9 of LM3914 No. 1 is held low enough to force LED No. 10 off when *any* higher LED is illuminated. While 100μA does not normally produce significant LED illumination, it may be noticeable when using high-efficiency LEDs in a dark environment. If this is bothersome, the simple cure is to shunt LED No. 11 with a 10k resistor. The 1V IR drop is more than the 900mV worst case required to hold off LED No. 10 yet small enough that LED No. 11 does not conduct significantly.

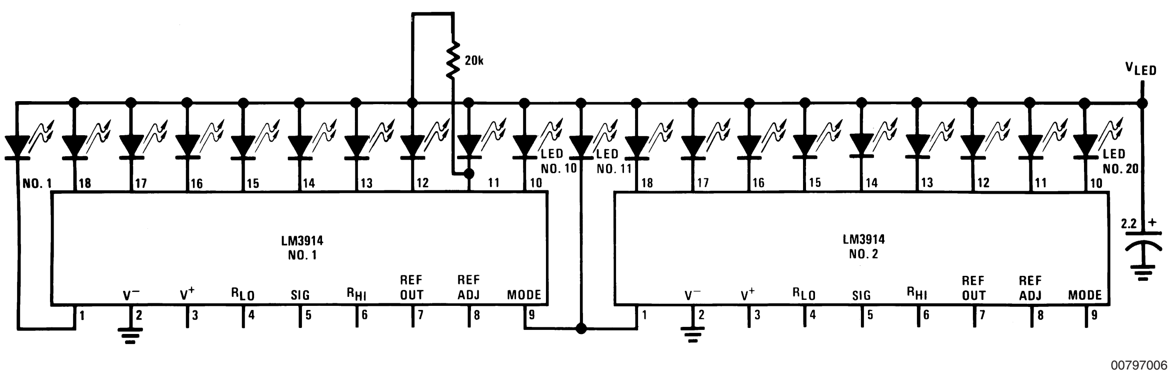
OTHER DEVICE CHARACTERISTICS

The LM3914 is relatively low-powered itself, and since any number of LEDs can be powered from about 3V, it is a very efficient display driver. Typical standby supply current (all LEDs OFF) is 1.6mA (2.5mA max). However, any reference loading adds 4 times that current drain to the V^+ (pin 3) supply input. For example, an LM3914 with a 1mA reference pin load (1.3k), would supply almost 10mA to every LED while drawing only 10mA from its V^+ pin supply. At full-scale, the IC is typically drawing less than 10% of the current supplied to the display.

The display driver does not have built-in hysteresis so that the display does not jump instantly from one LED to the next. Under rapidly changing signal conditions, this cuts down high frequency noise and often an annoying flicker. An "overlap" is built in so that at no time between segments are all LEDs completely OFF in the dot mode. Generally 1 LED fades in while the other fades out over a mV or more of range (Note 3). The change may be much more rapid between LED No. 10 of one device and LED No. 1 of a *second* device "chained" to the first.

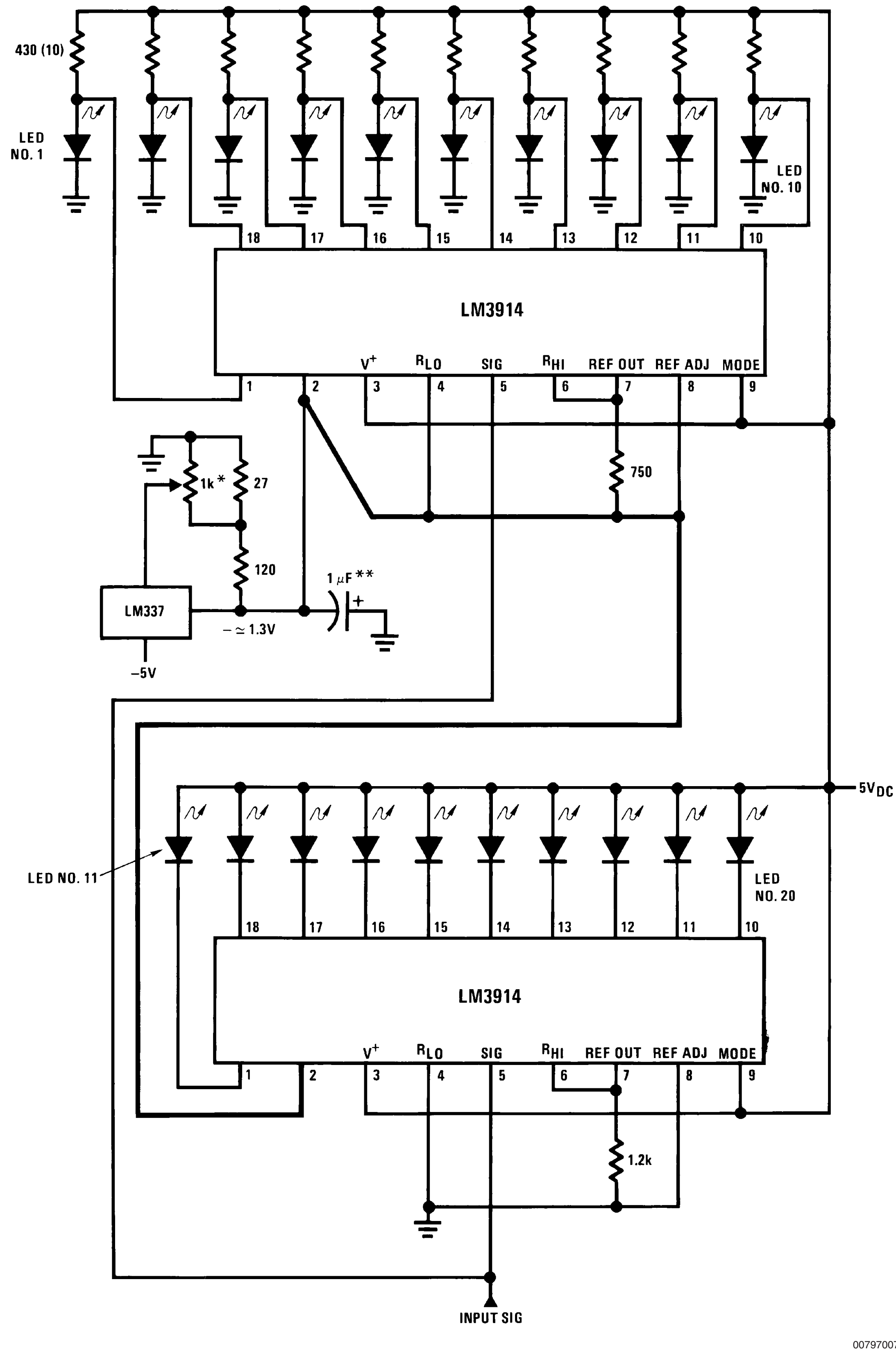
The LM3914 features individually current regulated LED driver transistors. Further internal circuitry detects when any driver transistor goes into saturation, and prevents other circuitry from drawing excess current. This results in the ability of the LM3914 to drive and regulate LEDs powered from a pulsating DC power source, i.e., largely unfiltered. (Due to possible oscillations at low voltages a nominal bypass capacitor consisting of a 2.2μF solid tantalum connected from the pulsating LED supply to pin 2 of the LM3914 is recommended.) This ability to operate with low or fluctuating voltages also allows the display driver to interface with logic circuitry, opto-coupled solid-state relays, and low-current incandescent lamps.

Cascading LM3914s in Dot Mode



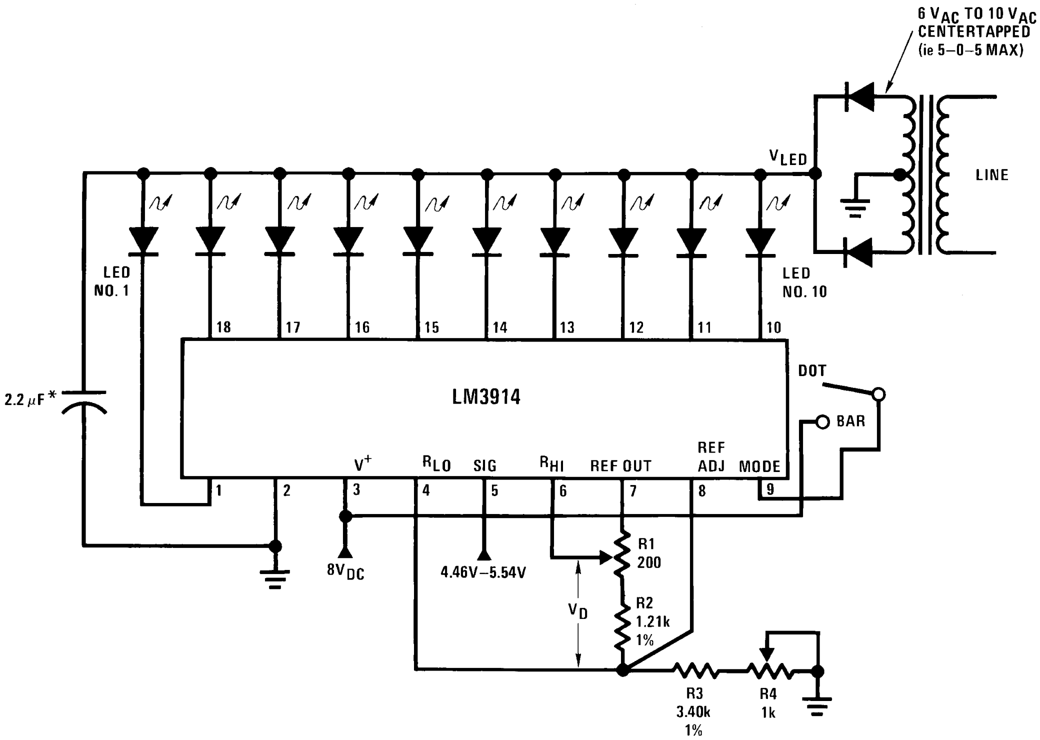
Typical Applications

Zero-Center Meter, 20-Segment



Typical Applications (Continued)

Expanded Scale Meter, Dot or Bar



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*This application illustrates that the LED supply needs practically no filtering

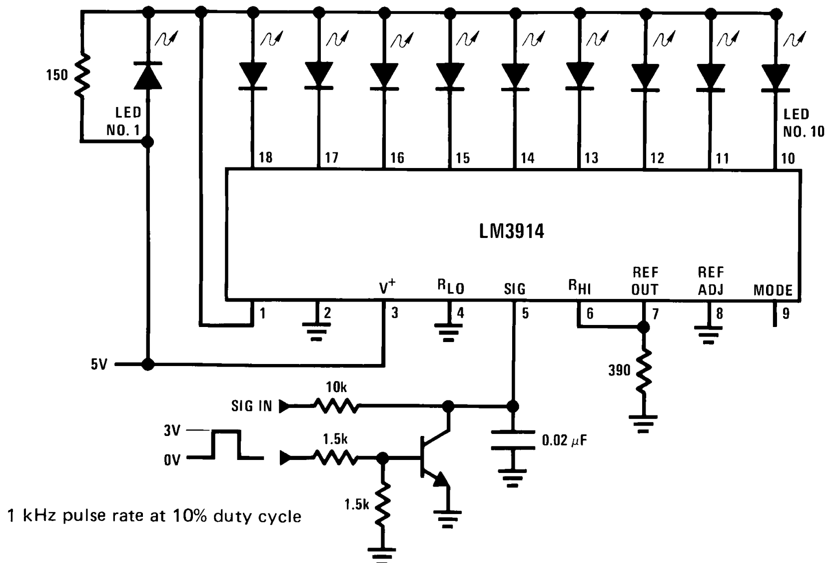
Calibration: With a precision meter between pins 4 and 6 adjust R1 for voltage V_D of 1.20V. Apply 4.94V to pin 5, and adjust R4 until LED No. 5 just lights. The adjustments are non-interacting.

Application Example:
Grading 5V Regulators

Highest No. LED on	Color	$V_{OUT(MIN)}$
10	Red	5.54
9	Red	5.42
8	Yellow	5.30
7	Green	5.18
6	Green	5.06
	5V	
5	Green	4.94
4	Green	4.82
3	Yellow	4.7
2	Red	4.58
1	Red	4.46

Typical Applications (Continued)

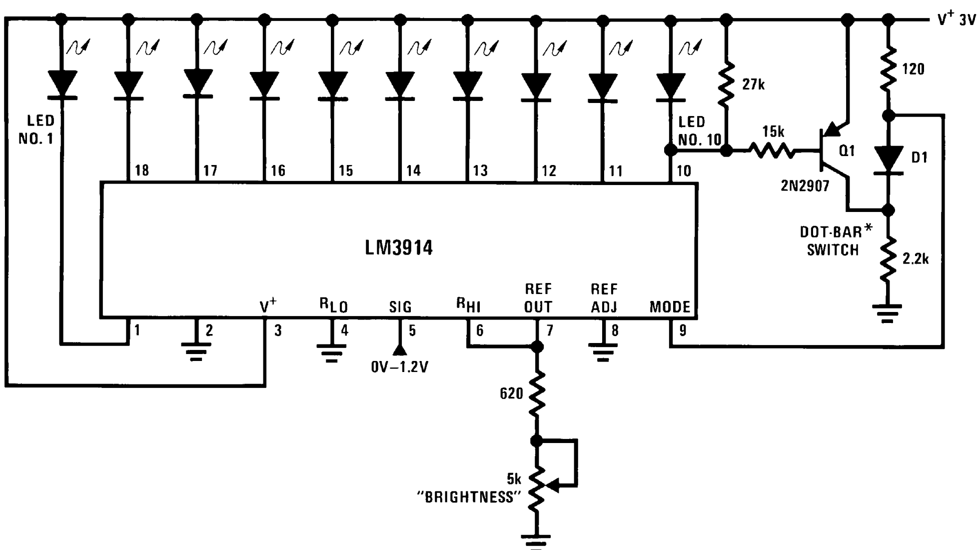
"Exclamation Point" Display



00797009

LEDs light up as illustrated with the upper lit LED indicating the actual input voltage. The display appears to increase resolution and provides an analog indication of overrange.

Indicator and Alarm, Full-Scale Changes Display from Dot to Bar

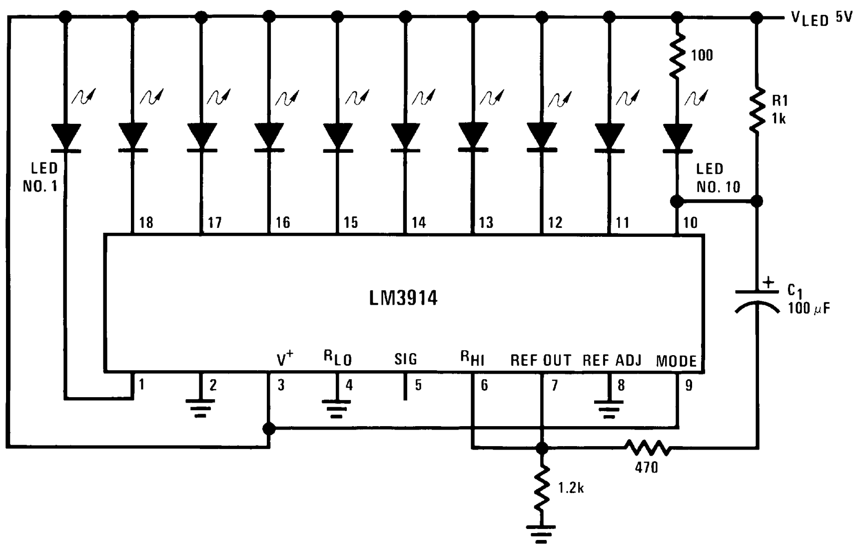


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*The input to the Dot-Bar Switch may be taken from cathodes of other LEDs. Display will change to bar as soon as the LED so selected begins to light.

Typical Applications (Continued)

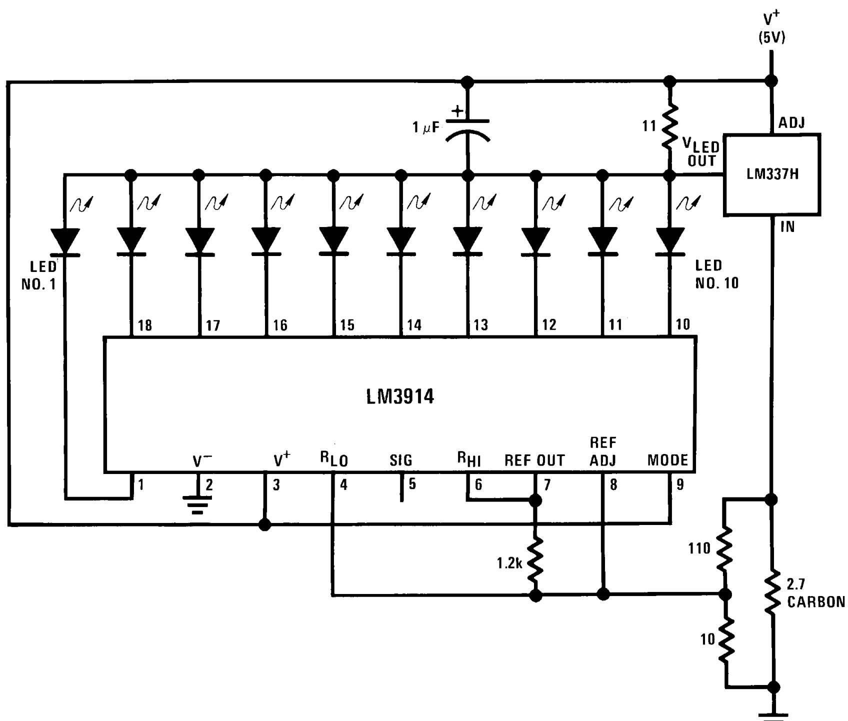
Bar Display with Alarm Flasher



00797011

Full-scale causes the full bar display to flash. If the junction of R1 and C1 is connected to a different LED cathode, the display will flash when that LED lights, and at any higher input signal.

Adding Hysteresis (Single Supply, Bar Mode Only)

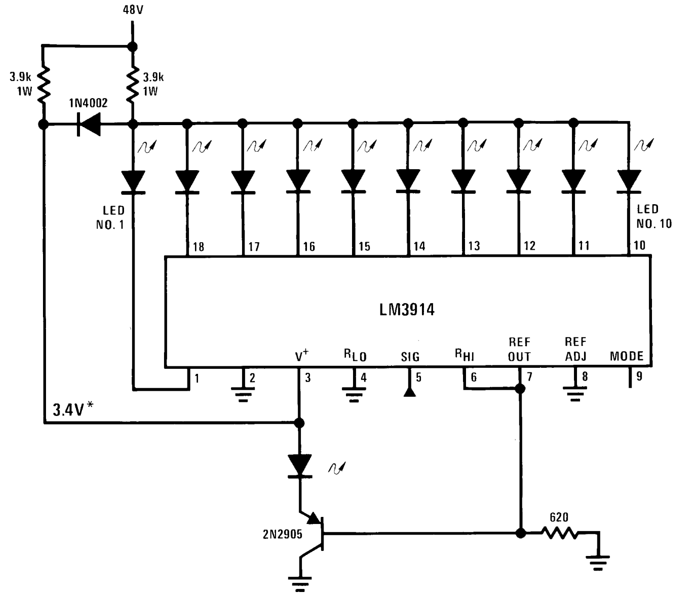


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Hysteresis is 0.5 mV to 1 mV

Typical Applications (Continued)

Operating with a High Voltage Supply (Dot Mode Only)



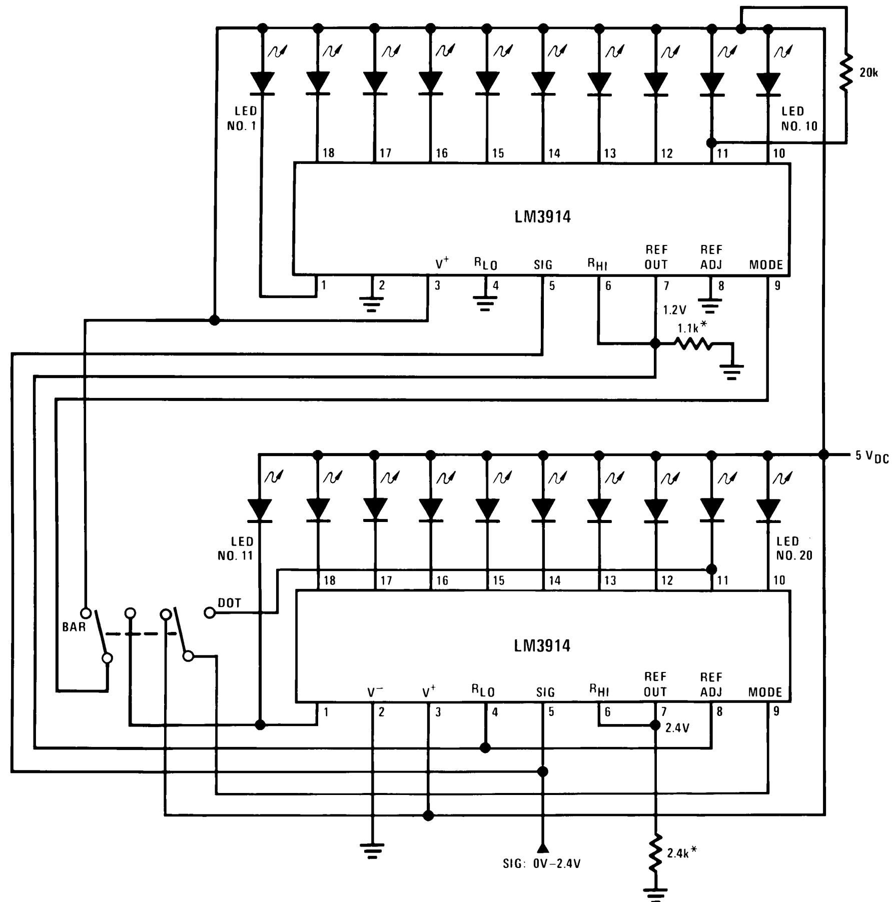
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The LED currents are approximately 10mA, and the LM3914 outputs operate in saturation for minimum dissipation.

*This point is partially regulated and decreases in voltage with temperature. Voltage requirements of the LM3914 also decrease with temperature.

Typical Applications (Continued)

20-Segment Meter with Mode Switch



00797014

*The exact wiring arrangement of this schematic shows the need for Mode Select (pin 9) to sense the V^+ voltage exactly as it appears on pin 3.

Programs LEDs to 10mA

Application Hints

Three of the most commonly needed precautions for using the LM3914 are shown in the first typical application drawing showing a 0V–5V bar graph meter. The most difficult problem occurs when large LED currents are being drawn, especially in bar graph mode. These currents flowing out of the ground pin cause voltage drops in external wiring, and thus errors and oscillations. Bringing the return wires from signal sources, reference ground and bottom of the resistor string (as illustrated) to a single point very near pin 2 is the best solution.

Long wires from V_{LED} to LED anode common can cause oscillations. Depending on the severity of the problem 0.05µF to 2.2µF decoupling capacitors from LED anode common to pin 2 will damp the circuit. If LED anode line wiring is inaccessible, often similar decoupling from pin 1 to pin 2 will be sufficient.

If LED turn ON seems slow (bar mode) or several LEDs light (dot mode), oscillation or excessive noise is usually the problem. In cases where proper wiring and bypassing fail to stop oscillations, V^+ voltage at pin 3 is usually below suggested limits. Expanded scale meter applications may have one or both ends of the internal voltage divider terminated at relatively high value resistors. These high-impedance ends should be bypassed to pin 2 with at least a 0.001µF capacitor, or up to 0.1µF in noisy environments.

Power dissipation, especially in bar mode should be given consideration. For example, with a 5V supply and all LEDs programmed to 20mA the driver will dissipate over 600mW. In this case a 7.5Ω resistor in series with the LED supply will cut device heating in half. The negative end of the resistor should be bypassed with a 2.2µF solid tantalum capacitor to pin 2 of the LM3914.

Turning OFF of most of the internal current sources is accomplished by pulling positive on the reference with a current source or resistance supplying 100µA or so. Alternately, the input signal can be gated OFF with a transistor switch.

Other special features and applications characteristics will be illustrated in the following applications schematics. Notes have been added in many cases, attempting to cover any special procedures or unusual characteristics of these applications. A special section called “Application Tips for the LM3914 Adjustable Reference” has been included with these schematics.

Application Hints (Continued)

APPLICATION TIPS FOR THE LM3914 ADJUSTABLE REFERENCE

Greatly Expanded Scale (Bar Mode Only)

Placing the LM3914 internal resistor divider in parallel with a section (≃230Ω) of a stable, low resistance divider greatly reduces voltage changes due to IC resistor value changes with temperature. Voltage V_1 should be trimmed to 1.1V first by use of R2. Then the voltage V_2 across the IC divider string can be adjusted to 200mV, using R5 without affecting V_1. LED current will be approximately 10mA.

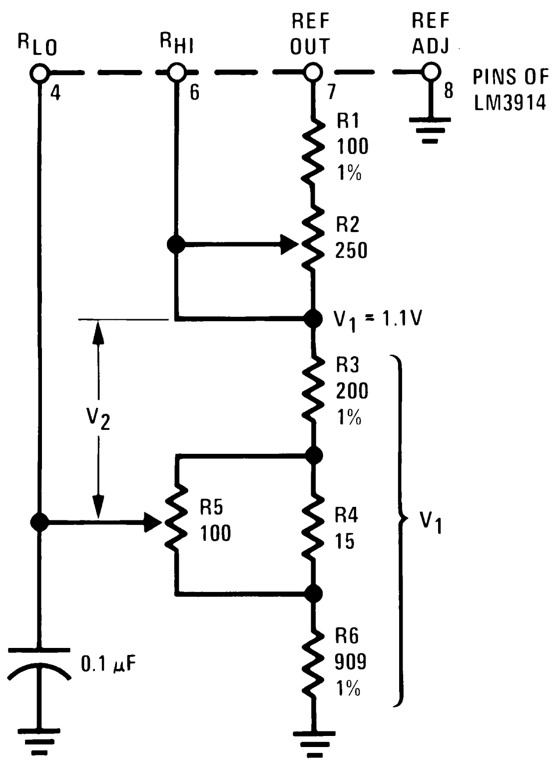
Non-Interacting Adjustments For Expanded Scale Meter (4.5V to 5V, Bar *or* Dot Mode)

This arrangement allows independent adjustment of LED brightness regardless of meter span and zero adjustments.

First, V_1 is adjusted to 5V, using R2. Then the span (voltage across R4) can be adjusted to exactly 0.5V using R6 without affecting the previous adjustment.

R9 programs LED currents within a range of 2.2mA to 20mA after the above settings are made.

Greatly Expanded Scale (Bar Mode Only)



00797015

Adjusting Linearity Of Several Stacked dividers

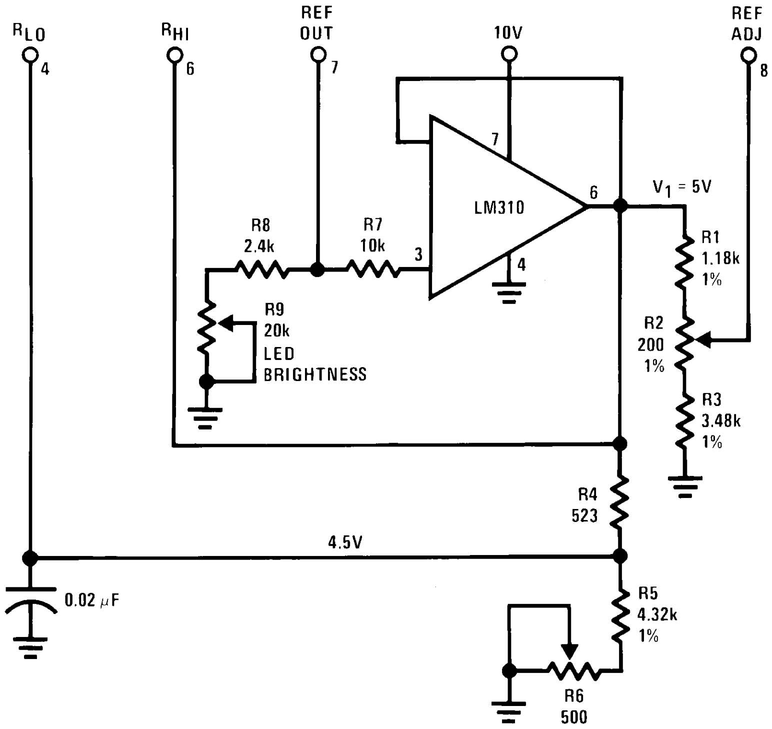
Three internal voltage dividers are shown connected in series to provide a 30-step display. If the resulting analog meter is to be accurate and linear the voltage on each divider must be adjusted, preferably without affecting any other adjustments. To do this, adjust R2 first, so that the voltage across R5 is exactly 1V. Then the voltages across R3 and R4 can be independently adjusted by shunting each with selected resistors of 6kΩ or higher resistance. This is possible because the reference of LM3914 No. 3 is acting as a constant current source.

The references associated with LM3914s No. 1 and No. 2 should have their Ref Adj pins (pin 8) wired to ground, and their Ref Outputs loaded by a 620Ω resistor to ground. This makes available similar 20mA current outputs to all the LEDs in the system.

If an independent LED brightness control is desired (as in the previous application), a unity gain buffer, such as the LM310, should be placed between pin 7 and R1, similar to the previous application.

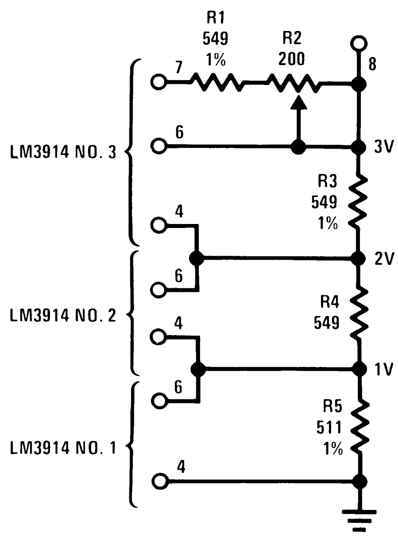
Application Hints (Continued)

Non-Interacting Adjustments for Expanded Scale Meter (4.5V to 5V, Bar *or* Dot Mode)



00797016

Adjusting Linearity of Several Stacked Dividers



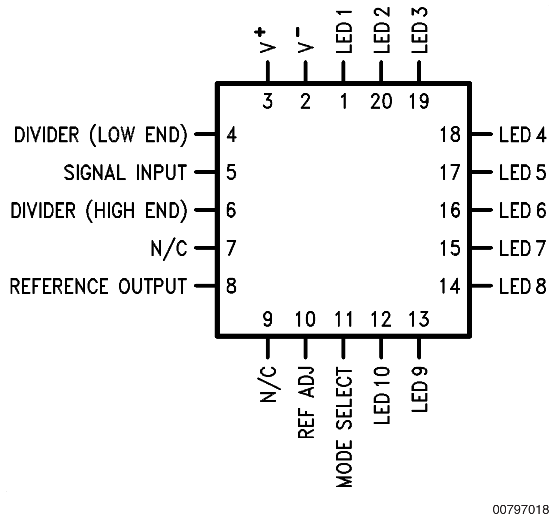
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Other Applications

- "Slow"—fade bar or dot display (doubles resolution)
- 20-step meter with single pot brightness control
- 10-step (or multiples) programmer
- Multi-step or "staging" controller
- Combined controller and process deviation meter
- Direction and rate indicator (to add to DVMs)
- Exclamation point display for power saving
- Graduations can be added to dot displays. Dimly light every other LED using a resistor to ground
- Electronic "meter-relay"—display could be circle or semi-circle
- Moving "hole" display—indicator LED is dark, rest of bar lit
- Drives vacuum-fluorescent and LCDs using added passive parts

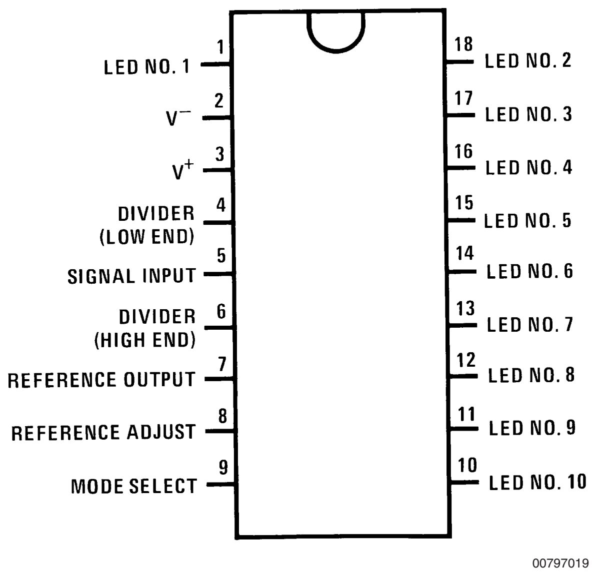
Connection Diagrams

Plastic Chip Carrier Package



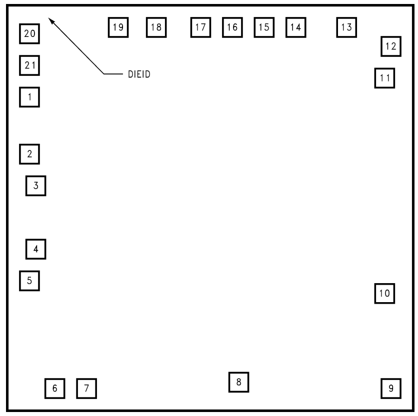
Top View
Order Number LM3914V
See NS Package Number V20A

Dual-in-Line Package



Top View
Order Number LM3914N-1
See NS Package Number NA18A
Order Number LM3914N *
See NS Package Number N18A
*** Discontinued, Life Time Buy date 12/20/99**

LM3914 MDC MWC Dot/Bar Display Driver



00797035

Die Layout (D - Step)

Die/Wafer Characteristics

Fabrication Attributes		General Die Information	
Physical Die Identification	3914	Bond Pad Opening Size (min)	94µm x 105µm
Die Step	D	Bond Pad Metalization	ALUMINUM
Physical Attributes		Passivation	VOM NITRIDE
Wafer Diameter	150mm	Back Side Metal	Bare Back
Dise Size (Drawn)	2591µm x 2438µm 102.0mils x 96.0mils	Back Side Connection	Floating
Thickness	330µm Nominal		
Min Pitch	175µm Nominal		

Special Assembly Requirements:
Note: Actual die size is rounded to the nearest micron.

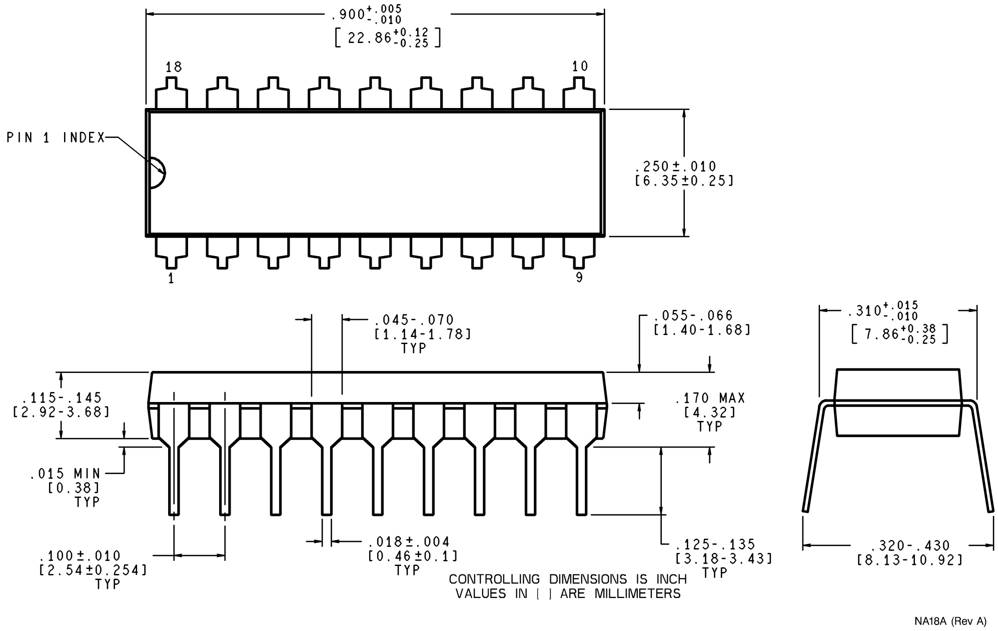
Die Bond Pad Coordinate Locations (D - Step)						
(Referenced to die center, coordinates in µm) NC = No Connection, N.U. = Not Used						
SIGNAL NAME	PAD# NUMBER	X/Y COORDINATES		PAD SIZE		
		X	Y	X		Y
LED NO.1	1	-1086	732	105	x	105
V-	2	-1086	343	105	x	105
V-	3	-1040	171	105	x	105
V+	4	-1052	-206	105	x	105
DIV LOW END	5	-1086	-377	105	x	105
SIG INPUT	6	-903	-1154	101	x	105
DIV HIGH END	7	-745	-1160	105	x	94
REF OUTPUT	8	224	-1126	105	x	94
REF ADJ	9	1086	-1154	105	x	105
MODE SEL	10	1057	-475	94	x	105
LED NO.10	11	1057	869	94	x	128
LED NO.9	12	1086	1052	105	x	105
LED NO.8	13	846	1160	105	x	94
NC	14	537	1154	105	x	105
LED NO.7	15	343	1154	105	x	105
NC	16	171	1154	82	x	105
LED NO.6	17	0	1154	105	x	105

Die/Wafer Characteristics (Continued)

LED NO.5	18	-320	1154	105	x	105
LED NO.4	19	-526	1154	105	x	105
LED NO.3	20	-1086	1086	105	x	105
LED NO.2	21	-1086	903	105	x	105

IN U.S.A	
Tel #:	1 877 Dial Die 1 877 342 5343
Fax:	1 207 541 6140
IN EUROPE	
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IN ASIA PACIFIC	
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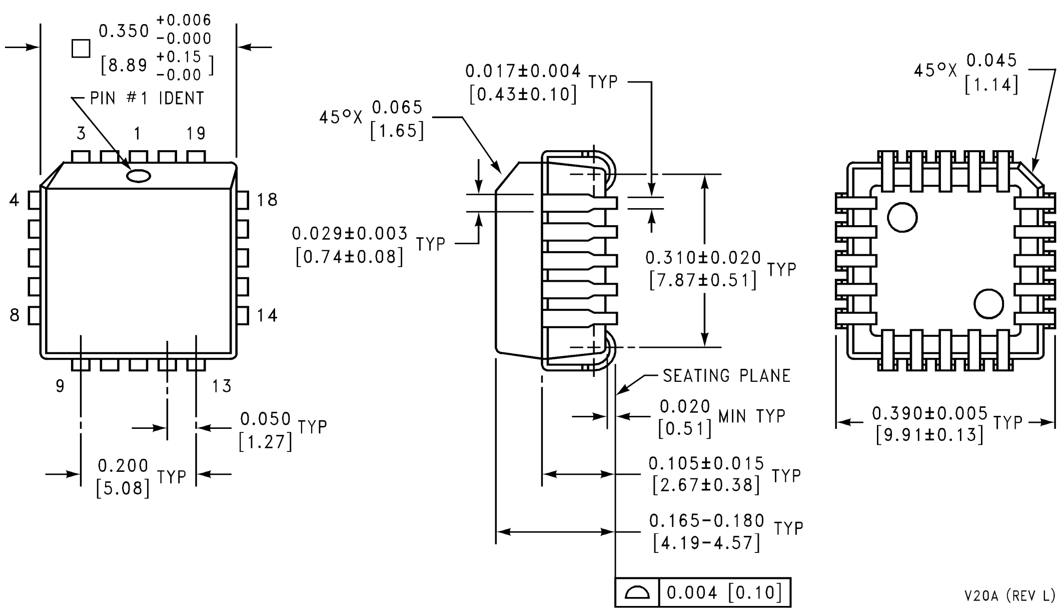
Physical Dimensions inches (millimeters) unless otherwise noted



Note: Unless otherwise specified.

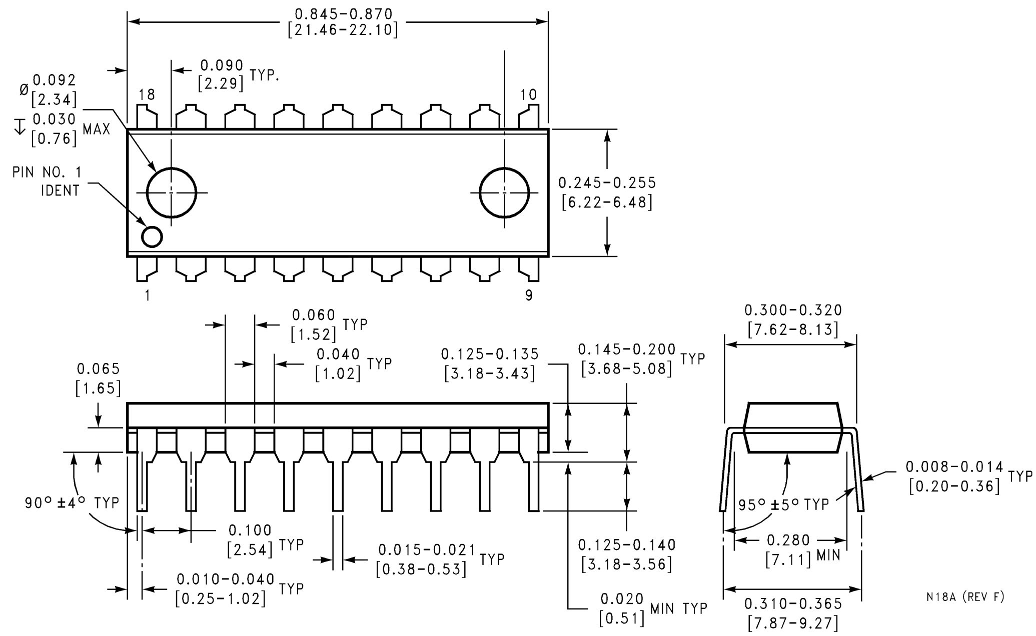
1. Standard Lead Finish:
   200 microinches /5.08 micrometer minimum
   lead/tin 37/63 or 15/85 on alloy 42 or equivalent or copper
2. Reference JEDEC registration MS-001, Variation AC, dated May 1993.

Dual-In-Line Package (N)
Order Number LM3914N-1
NS Package Number NA18A



Plastic Chip Carrier Package (V)
Order Number LM3914V
NS Package Number V20A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



Dual-In-Line Package (N)
Order Number LM3914N *
NS Package Number N18A
*** Discontinued, Life Time Buy date 12/20/99**

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